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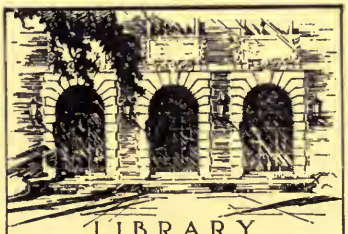
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THE PLANKTONIC FRESHWATER SPECIES OF MICROCYSTIS

BY

FRANCIS DROUET

CURATOR OF CRYPTOGAMIC BOTANY
FIELD MUSEUM OF NATURAL HISTORY

and

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DEPARTMENT OF BOTANY
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THE PLANKTONIC FRESHWATER SPECIES OF MICROCYSTIS

FRANCIS DROUET and WILLIAM A. DAILY

Species of Microcystis are perhaps the most common algae that develop as water-blooms in fresh water. The 'simple' structure of these plants, their infinite morphological variability, and their universal distribution in temperate and tropical zones have made them favorite subjects for the description of 'new species'. The most important recent discussion of the group is that of Crow in New Phytologist, vol. 22 (1923), a study of material collected in Ceylon and an evaluation of figures and descriptions found in a rather limited mass of literature.

This study was begun as an inquiry into the reliability of the many old and recent descriptions of species in the group. More than a thousand specimens on file in American and European herbaria and in the personal collections of many living collectors were assembled, and observations were made upon the morphology of the plants in each specimen. An attempt was then made to arrange all of the specimens in groups sufficiently homogeneous to deserve specific appellations. Much of the material examined was in the dried condition; quite as much was seen in formalin, alcohol, and other liquid preservatives. The lot included specimens upon which the original descriptions of most of the commonly reported species were based, as well as those which illustrate the specific distinctions made by important students of the algae. Field observations were made upon living plants during a period of several years.

Morphology

The three species of the genus as here circumscribed are rather similar in structure. The plant body is composed usually of many cells. Each cell consists of a spherical protoplast surrounded by a layer of structureless hyaline gelatinous material which is confluent with that of the neighboring cells. The protoplasm is blue-green and contains large irregular granules, the pseudovacuoles, which appear black in transmitted light and red in reflected light. Where the plants are subjected to certain changes in the environment or to long-continued immersion in liquid preservatives, the pseudovacuoles disappear and the protoplasm becomes almost homogeneous. The

cell membrane is thin, conspicuous in some plants, scarcely evident in others. The gelatinous material, termed the *sheath* in myxophycean parlance, is so homogeneous throughout the plant body that it is impossible to demonstrate with the usual staining methods just what part of it belongs properly to each individual cell. In most plants, this material is firm; it holds the protoplasts in more or less permanent positions within the plant body. In many, it is so firm, and its outer layer so highly refractive, that it is conspicuously delimited from the surrounding medium. In others, its outer limits are so indefinite as to be made visible only by careful staining techniques; in such plants, bacteria and the organisms passing under the name of *Phormidium mucicola* Naum. & Huber. are often abundant in the diffluent outer layer of gelatinous material. All gradations between forms which are conspicuously delimited and those which are most indefinitely so are illustrated in most collections.

The plant bodies are highly variable in shape and size. In certain collections, especially those in which the plants are scarce in the plankton, spherical plants predominate. In other collections, especially those from heavy water-blooms, the plants are of all conceivable shapes: spherical, ovoid, cylindrical, torulose, lobed, branched, and perforated. Other collections contain chiefly elongated and narrowly cylindrical branching plants. A variation of this type includes those in the form of branching chains of spherical, ovoid, or lobed cell-masses. A peculiar form is seen in certain rare collections, in which the plant bodies or their lobes consist of very few cells, so that the protoplasts appear to be grouped vaguely in eights. In certain collections, the protoplasts are distributed only in the periphery of the plants or their lobes and in general arrangement are reminiscent of those of species of Coelosphaerium. In very heavy water-blooms of *M. aeruginosa*, compact masses as great as several centimeters in thickness may be formed, with the individual plants agglutinated and the gelatinous material of each confluent with that of neighboring plants. Every type of plant body described above, with infinite variation, is exemplified in most collections, often in the same field of the microscope. One cannot (unless arbitrarily) select out of the diversity of shapes represented in a plankton haul a single shape which is 'typical' of a species, for all shapes appear to be characteristic of each species. In all the material studied, the size of plants and protoplasts, the degree of diffluence of the gelatinous material, the color of the protoplasm, the aspect of the pseudovacuoles, and the appearance of

the cell membranes illustrate all gradations between wide limits of variability.

Alteration in the appearance of plants occurs commonly during collecting, preserving, and storing of material. Plants lifted gently from the habitat and examined at once under the microscope often differ in shapes from those collected in a tow-net; it is probable that pressure of the water and friction of the plants with each other and with the sides of the net bring about such changes. If the collection is preserved immediately by rapid drying, the color and granulation of the protoplasm, the pseudovacuoles, the cell membranes, and the gelatinous matrices retain permanently (at least under usual conditions of storage in herbaria) the appearance characteristic of the plants when collected; such changes as do occur are confined to flattening of the protoplasts. If, after being collected, the material is preserved at once by the addition of formalin or alcohol, the plants likewise retain the aspect of living ones; however, if they are stored in this manner for a year or more, pseudovacuoles often disappear, the color of the mass is lost, the cell membranes become indistinct, and the protoplasts become dissociated from each other. Pseudovacuoles soon disappear where living plants are kept for some hours in closed bottles before they are preserved; often the mass assumes a yellowish color under such conditions. Here a lack of oxygen may be responsible for changes in appearance. Bacteria multiply in such collections, and by their action the outlines of the plants are altered. Exposure of such collections to direct sunlight before preservation causes similar pathological effects. Differences in morphology of plants and protoplasts in preserved collections may thus be attributed to the treatment of material during and after its removal from the habitat, and the preserved material may bear little resemblance to living material in the mass from which it was taken. Pressure and friction involved in the collecting with nets, exclusion of oxygen from the living plants after collecting, overheating, over-sufficient exposure to direct sunlight, and long standing in liquid preservatives may bring about radical changes in the appearance of the plants.

We may assume that these same 'unfavorable' conditions are duplicated in ponds, lakes, and streams which give rise to water-blooms of Microcystis. In every mass of plants in the plankton the individuals are constantly moving with currents of water or in response to the force of gravity. Large numbers of plants may live throughout the season under presumably optimum conditions in

the limnoplankton. Others may settle to the bottom and there in a medium deficient in oxygen become pathological or die. Both dead and dying individuals may again be carried into the limnoplankton and mixed with the mass as collected. Plants may be carried by waves onto shores, where they pile up and are exposed to overheating and direct sunlight; these also may be washed back into the limnoplankton and form part of the mass which is collected. Plants exposed to the direct sunlight in very shallow water may become pathological and later be mixed with the mass collected. In fact, collections are often taken from shallow water or from shores rather than from the limnoplankton. A well developed water-bloom of these organisms, we may therefore assume, is composed of millions of individual plants, each with a slightly different individual history, each unique in the appearance of all of its parts according to the 'adverse' and 'favorable' conditions to which it has been exposed during its own, and probably its ancestral, history.

Reproduction in the genus is by fragmentation of the plant bodies. Lobes consisting of several or many cells are formed, or in filamentous plants spherical or ovoid aggregations of cells appear as segregated masses within the plant body. As the cells divide and increase in size, the lobes and aggregations of cells increase in size and ultimately become separated from the other parts. In rare instances, single cells are seen to form such lobes or separated fragments. Fragmentation may also be brought about by mechanical action of various agents before, during, or after collecting. Under favorable conditions, cell division and reproduction take place so rapidly that millions of individual plants appear in the plankton within a short period of time; these floating to the surface constitute the peculiar mass termed *water-bloom*.

For taxonomic and morphological studies, the method of preservation here recommended, as with all other Myxophyceae, is by drying as quickly as possible on both paper and mica as soon as the material is collected. The disadvantages of preservation in formalin and alcohol have been mentioned above.

The Species

An exhaustive treatment of the genus *Microcystis* Kütz. must await the work of a monographer who can study as a whole the generic complex Microcystis-Aphanocapsa-Aphanothece. If the planktonic freshwater species of Microcystis are to be segregated as a distinct genus, as our studies here lead us to suppose, they must

perhaps be designated by the generic name *Polycystis* Kütz., Tab. Phyc. 1: 7 (1846). Species with elongated cells should be transferred to Aphanothece. Those which have spherical cells and bodies of indeterminate growth and sedentary habit are more properly placed in Aphanocapsa.

In the group of species here circumscribed are those Myxophyceae whose plant bodies contain few to many spherical protoplasts arranged without regular order within homogeneous, hyaline gelatinous matrices of microscopic size and diverse shapes; all are planktonic and unattached to substrata even in juvenile stages. Those species previously described in Microcystis which, from an examination of their original specimens, prove to be members of other genera are listed as *Nomina Excludenda* at the end of the treatment of species below. Those for which no authentic material has been seen and which from their figures and descriptions appear to belong to other groups are listed as *Nomina Inquirenda.*

Herbaria and private collections in which specimens cited are to be found are indicated by means of the following abbreviations: B, Brooklyn Botanic Garden; Ber, Botanisches Museum, Berlin-Dahlem; BM, British Museum (Natural History); C, Herbarium of the University of California; D, Herbarium of Francis Drouet; Da, Herbarium of W. A. Daily; F, Farlow Herbarium of Harvard University; FM, Field Museum of Natural History; G, Herbarium of Goucher College, Baltimore; K, Botanisk Museum, Kjøbenhavn; L, Rijksherbarium, Leiden; Mi, Herbarium of the University of Michigan; Min, Herbarium of the University of Minnesota; Mo, Missouri Botanical Garden; N, New York Botanical Garden; Ne, Herbarium of the University of Nebraska; Pa, Academy of Natural Sciences, Philadelphia; Pr, Herbarium of G. W. Prescott; PW, collection of Philip W. Wolle in Field Museum of Natural History; S, Naturhistoriska Riksmuseet, Stockholm; T, Herbarium of Wm. R. Taylor; Ta, the collection of C. E. Taft; U, United States National Herbarium.

We are indebted to many persons who have contributed to the success of this work: Dr. E. H. Ahlstrom, Dr. H. C. Bold, Mr. K. Damann, Dr. Samuel Eddy, Dr. G. E. Hutchinson, Dr. B. B. McInteer, Mr. C. M. Palmer, Dr. Ruth Patrick, Dr. G. W. Prescott, Mr. C. B. Reif, Dr. C. E. Taft, Dr. L. H. Tiffany, Dr. Willis L. Tressler, Dr. Wm. Randolph Taylor, Dr. G. T. Velasquez, Dr. E. R. Walker, Dr. Stillman Wright, and Dr. H. C. Yingling have sent for study many specimens from their private collections; Miss

Rosalie Weikert and Mr. G. Wittrock have given assistance in the bibliographic work.

The following key may be of assistance in the determination of species in samples where the plants occur in abundance:

I. Mass developing in loose granular layers in shallow waters of ponds fed by limestone springs; protoplasts bright blue-green, 2–3 μ in diameter, pseudovacuoles absent ..... M. GLAUCA

II. Mass strictly planktonic and often developing as heavy water-blooms; pseudovacuoles present (often absent in material preserved in formalin or alcohol)

A. Protoplasts 0.5–2 μ in diameter, pseudovacuoles small and inconspicuous ..... M. INCERTA

B. Protoplasts 2.5–10.5 μ in diameter, pseudovacuoles large and conspicuous ..... M. AERUGINOSA

MICROCYSTIS **glauca** (Wolle) Drouet & Daily, **comb. nov.** *Anacystis glauca* Wolle, Bull. Torr. Bot. Club 6: 182 (1877).—Here possibly belong, if we can judge by descriptions and figures, the following: *Pleurococcus pulvereus* Wood, Smiths. Contrib. Knowl. 241: 79 (1872); *Anacystis pulverea* Wolle, F. W. Alg. U. S., 329 (1887); *Polycystis pulverea* Wolle apud Hansg., Prodr. Alg. Fl. Böhmen 2: 145 (1892).

Plantae multi-(raro 1-pauci-)cellulares, forma variabilissimae, sphaericae, ovoideae, cylindricae, varie et irregulariter lobatae vel invaginatae, saepe clathratae, toruloso-cylindricae, aut conferte confluentes, in 'strato indeterminato fundis calcariorum fontium' (sec. Wolle) invenientes; protoplastidibus globosis aut in divisione fere hemisphaericis, 2μ ad 3μ crassis, sine ordine regulari in gelatino vaginali distributis; gelatino vaginali hyalino, homogeneo, ad marginem distincte delimitato vel plus minusve (nonnumquam omnino) diffluenti; protoplasmate laete aerugineo, non granuloso, sine pseudovacuolis (v. s.).

Specimens seen: PENNSYLVANIA: in fonte rupium calcareorum ad Bethlehem, *F. Wolle*, 1884 (TYPE in Wittr. & Nordst., Alg. exs. 796, PW; isotypes, L, N, Ne); lime stone springs, *F. Wolle* (L); 'Anacystis glauca' (N).

Mr. Philip W. Wolle has made the following transcript of the two entries in Francis Wolle's notebooks: "October 25, 1877. Anacystis glauca, n.sp. Glaucous green, covers the bottoms of ponds of lime stone spring water. Thallus of families, gelatinous, colorless, soon diffused, oval or ovate, discernible by various degrees of density of cellules rather than by a distinct outline. Cells very small and very numerous, light aeruginous. Family .005″ more or less. Cellules .00008–.0001 rarely .000116.″ Collected in Sheimer's Spring

[near Bethlehem, Pennsylvania]. In large masses on the bottom of fresh lime stone water ponds, tea green—dipped it up by mug fulls. Teg. gelatinous, colorless, hardly discernible except by particles of dirt adhering." "September 23, 1884. Anacystis glauca,—cells .00012—.00014". Cysts diffluent, quickly diffuse, forms a dense deposit in lime stone springs, glaucous green color, very slightly gelatinous, necessary to add gum water to make it adhere to paper—this changes color to darker green. Pond water—Farmersville [near Easton, Pennsylvania]". The copious and well preserved material left by Francis Wolle shows beyond doubt that this species is one of Microcystis. It is a kind of plant, however, very different from that popularly reported in the limnoplankton of ponds and lakes throughout the world under the name *M. pulverea.* The latter receives treatment below under *M. incerta* Lemm. Wolle, in his *Fresh-water Algae of the United States* (1887), identified his *Anacystis glauca* with *Pleurococcus pulvereus* Wood. It is now certain that Wolle had only Wood's original description of *P. pulvereus* upon which to base this decision. Wood's description appears to be somewhat ambiguous; the location of his herbarium is unknown to us at the present time. It has therefore seemed advisable to accept Wolle's *Anacystis glauca* as the first name to designate the species with certainty.

MICROCYSTIS INCERTA Lemm., Kryptogamenfl. Mark Brandenb. 3: 76 (1907). *Polycystis incerta* Lemm., Forschungsber. biol. Sta. Plön 7: 132 (1899). *Clathrocystis holsatica* Lemm., ibid. 10: 150 (1903). *Microcystis holsatica* Lemm., Kryptogamenfl. Mark Brandenb. 3: 77 (1907). *M. pulverea* var. *incerta* Crow, New Phytol. 22: 66 (1923). *M. pallida* Mig., Krypt. Germ. Austr. Helvet. Exs. 52 (Algen): 264 (1931).—Here belong also, if we can judge by original descriptions and figures, the following: *Polycystis pallida* Lemm., Bot. Centralbl. 76: 154 (1898); *P. stagnalis* Lemm., Ber. deutsch. bot. Ges. 18: 24 (1900); *Microcystis stagnalis* Lemm., Forschungsber. biol. Sta. Plön 10: 150 (1903); *M. incerta* var. *elegans* Lemm., loc. cit. (1903); *Clathrocystis holsatica* var. *minor* Lemm., Abh. Nat. Ver. Bremen 18: 151 (1905); *Microcystis holsatica* var. *minor* Lemm., Kryptogamenfl. Mark Brandenb. 3: 77 (1907); *M. pulverea* var. *incerta* f. *elongata* Crow, loc. cit. (1923); *M. exigua* Zalessky, Rév. gén. Bot. 38: 34 (1926).

Plantae multi-(raro 1-pauci-)cellulares, forma variabilissimae, sphaericae, ovoideae, cylindricae, varie et irregulariter lobatae vel invaginatae, saepe clathratae, toruloso-cylindricae, aut conferte

confluentes, inter alias algas planctonicas sparsae, demum denso 'flori aquae' invenientes; protoplastidibus globosis aut in divisione fere hemisphaericis, 0.5 μ ad 2 μ crassis, sine ordine regulari in gelatino vaginali distributis; gelatino vaginali hyalino, homogeneo, ad marginem distincte delimitato vel plus minusve diffluenti; protoplasmate pallide aerugineo, pseudovacuolis parvis praebentibus (v. v., v. s., v. in form.).

Specimens seen: SWEDEN: in lacu Wombsjön Scaniae, *O. Nordstedt*, Jun. 1901 (as *M. incerta* det. Lemmermann. Ber, C, N); duck pond, Lovestad, *B. Carlin-Nilsson*, July 1934 (D). BRANDENBURG: Teich bei Fürstenfelde bei Neudamm, *Itzigsohn & De Bary*, Sept. 1852 (as *Clathrocystis holsatica* det. Lemmermann, Ber). THÜRINGEN: im Plankton des Prinzenteichs, Eisenach, *W. Migula*, Aug. 1931 (ISOTYPES of *Microcystis pallida* Mig., Krypt. Germ. Austr. Helv. Exs. 264, Ber, F, FM, N, T). TRANSVAAL: tow netting in channel, Barberspan, *Mrs. G. E. Hutchinson 4*, Apr. 1928 (D). MINNESOTA: with *M. aeruginosa*, Heron Lake, Jackson County, *Minnesota Fish Commission*, July 1938 (FM). BRAZIL: with *M. aeruginosa*, Açude Velho near Campina Grande, Parahyba, *S. Wright 1570*, Mar. 1935 (D).

M. incerta is seldom encountered in files of herbarium specimens. It has been mentioned in the literature mainly by workers whose specimens are rarely placed in herbaria. Because of the small size of the protoplasts, it is easily confused with coccoid planktonic bacteria. Usually but few plants are seen in the plankton of a lake; less usually they develop into heavy water-blooms, as in the specimen cited above from Brandenburg and labeled *Clathrocystis holsatica* by Lemmermann.

MICROCYSTIS AERUGINOSA Kütz., Tab. Phyc. 1: 6 (1846). *Microhaloa aeruginosa* Kütz., Linnaea 8: 371 (1833). *M. ichthyoblabe* Breb. in Menegh., Monogr. Nostoch. Ital. 104 (1842). *Microcystis ichthyoblabe* Kütz., Phyc. Gener. 170 (1843). *Polycystis aeruginosa* Kütz., Tab. Phyc. 1: 9 (1846). *Polycystis ichthyoblabe* Kütz., ibid. 9 (1846). *Clathrocystis aeruginosa* Henfr., Trans. Microsc. Soc. London N. S. 4: 53 (1856). *Polycystis viridis* A. Br. in Rabenh. Alg. Eur. 21: 1415 (1862). *P. prasina* Wittr. in Wittr. & Nordst., Alg. Aq. Dulc. Exs. 6: 297 (1879). *P. flos-aquae* Wittr., ibid. 298 (1879). *Microcystis caerulea* Dickie, Journ. Linn. Soc. Bot. 18: 128 (1880). *Polycystis scripta* Richt. in Hauck & Richt., Phyk. Univ. 2: 92 (1887). *P. flos-aquae* var. *scripta* Hansg., Prodr. Algenfl. Böhmen 2: 144 (1892). *P. flos-aquae* var. *prasina* Hansg., loc. cit. (1892). *P. elabens* var. *ichthyoblabe* Hansg., ibid. 145 (1892). *P. aeruginosa* var. *major* Wittr. apud Hansg., loc. cit. (1892). *P.* (*Clathrocystis*) *insignis* Beck, Krypt. Exs. Mus. Vindob. 2: 227 (1896). *P. ochracea* Brand, Ber. Deutsch. Bot. Ges. 16: 200 (1898). *Microcystis viridis*

Lemm., Abh. Nat. Ver. Bremen 17: 342 (1903). *M. prasina* Lemm., Ark. f. Bot. 2 (2): 146 (1904). *M. flos-aquae* Kirchn. apud Lemm., Kryptogamenfl. Mark Brandenb. 3: 75 (1907). *M. scripta* Lemm., ibid. (1907). *M. ochracea* Lemm., ibid. 3: 76 (1907). *Clathrocystis robusta* Clark, Proc. Biol. Soc. Wash. 21: 94 (1908). *Microcystis aeruginosa* var. *major* G. M. Smith, Trans. Wisc. Acad. 18: 535 (1916). *M. robusta* Nygaard, Dansk Bot. Ark. 4 (10): 8 (1925). *M. aeruginosa* f. *occidentalis* Wm. R. Tayl., Amer. Journ. Bot. 15: 606 (1928).—Here also should be placed the following, if we can judge by original descriptions and figures: *Polycystis marginata* var. *minor* Hansg., Prodr. Algenfl. Böhmen 22: 145 (1892); *Microcystis protocystis* Crow, New Phytol. 22: 62 (1923); *M. pseudofilamentosa* Crow, ibid. 64 (1923); *M. fusca* Zalessky, Rev. Gén. Bot. 38: 33 (1926); *M. elabentoides* Zalessky, loc. cit. (1926); *M. floccosa* Zalessky, ibid. 34 (1926); *M. globosa* Zalessky, loc. cit. (1926); *M. angulata* Zalessky, loc. cit. (1926); *M. ramosa* Bharadw., Proc. Indian Acad. Sci. 2: 96 (1935).

Plantae multi-(raro 1-pauci-)cellulares, forma variabilissimae, sphaericae, ovoideae, cylindricae, varie et irregulariter lobatae vel invaginatae, saepe clathratae, toruloso-cylindricae, aut conferte confluentes, primum inter alias algas planctonicas sparsae, demum denso 'flori aquae' invenientes; protoplastidibus globosis aut in divisione fere hemisphaericis, 2.5 μ ad 10.5 μ crassis, sine ordine regulari in gelatino vaginali distributis; gelatino vaginali hyalino, homogeneo, ad marginem distincte delimitato vel plus minusve (saepe omnino) diffluenti; protoplasmate aeruginoso, pseudovacuolis praebentibus (v. v., v. s., v. in form.)

Specimens seen: LATVIA: Prov. Kurzeme, *H. Skuja*, Aug. 1924 (Da, FM). SWEDEN: in lacu Kälungen Daliae, *V. Wittrock*, Aug. 1866 (ISOTYPES of *Polycystis flos-aquae* Wittr., in Wittr. & Nordst. Alg. exs. 298, L, Min, N, Ne, PW), Sept. 1882 (Wittr. & Nordst., Alg. exs. 599, D, L, Min, N, Ne, PW); pond, Nötesjö, Malmöhus, *B. Carlin-Nilsson 525*, Aug. 1937 (D, N); Dagstorpssjön, Malmöhus, *Carlin-Nilsson 140*, Aug. 1931 (D, N); in lacu Lötsjön par. Funbo Uplandiae, *V. Wittrock* (Aresch., Alg. Scand. Exs. Ser. Nov. 429, FM, L), Oct. 1878 (Wittr. & Nordst., Alg. exs. 296, FM, L, Mi, Ne, PW); lake, Fiolen, Kronoberg, *Carlin-Nilsson 516*, July 1937 (D, N); in lacu Kälungen in Dalia, *Wittrock* (Aresch., Alg. Scand. Exs. Ser. Nov. 388, as *Aphanocapsa pulchra*, FM), Aug. 1862 (D); in lacu Mälaren ad Flottsund Uplandiae, *Wittrock*, Nov. 1878 (ISOTYPES of *Polycystis prasina* Wittr., in Wittr. & Nordst., Alg. Exs. 297, FM, L, Mi, Ne, PW, T, U); Hammarbysjö in Danviken, Stockholm, *G. Lagerheim*, 1882 (D); in lacu ad Mullsjö Vestrogothiae, *O. Nordstedt*, Aug. 1900 (Ber, N); Trehörningsjö, Upland, *O. Borge*, Sept. 1896 (N); with *Microcystis incerta*, in lacu Wombsjön Scaniae, *Nordstedt*, Jun. 1901 (C, N). DENMARK: in lacu prope Birkeröd, Selandia, *C. Ostenfeld-Hansen*, Aug. 1896 (D, K); Sjön Naerum, *C. Rasch*, Jun. 1880 (K); Lilleröd,

Sjaelland, *Th. Rosenvinge*, Sept. 1879 (K); Hut-sö, *Johs. Schmidt*, Sept. 1898 (K); Hofmansgave, Fionen, *Hofmann-Bang* (B). DANZIG: *Klinsmann*, 1858 (Ber).

GERMANY: Ostpreussen: Ockelsee bei Allenstein, *Caspary*, Aug. 1862 (Ber.). Westpreussen: Sawadda-See, *P. Hennings*, Sept. 1890 (Ber). Brandenburg: Wannensee, *Hennings*, Sept. 1892 (Henn. Phyk. March. 47c, Ber, F); Halensee, *Hennings*, Nov. 1890 (Henn. Phyk. March. 47b, Ber, F); Wilmersdorfer See (Berlin), *Hennings*, Juli 1882 (Ber; Henn. Phyk. March. 47a, Ber, F); Müggel-See, Friedrichshagen, *Hennings*, Aug. 1892 (Ber), Sept. 1892 (Henn. Phyk. March. 47d, Ber, F), *A. Braun* (Ber); in der Havel bei der Pfaueninsel, *Braun*, Aug. 1863 (Ber, Caput gegenüber, Oct. 1855 (Ber), bei Potsdam, *Bauer*, Aug. 1863 (Ber, D, L, F, N), *L. Rabenhorst*, Juli 1857 (L); Berlin, *Braun*, Aug. 1854 (Ber, L), *Jahn*, 1857 (Ber), Hort. Berol., *Braun*, Aug. 1852 (Ber); Golssen, *Schumann*, Juli 1865, 1866 (Ber); Grunewald-See bei Berlin, *G. Hieronymus*, Aug. 1891 (Ber); in einem Graben bei der kleinen Mühle, Neudamm, *Itzigsohn*, Mai 1855 (Ber); Gumnitzsee, Joachimsthal, *W. Panknin*, Aug. 1937 (Ber); im Tempelhofer Parkteiche bei Berlin, *Hennings*, Juli 1883 (Ber; Henn. Phyk. March. 46, Ber, F). Pommern: Wolgast-See bei Haeringsdorf, *A. Braun*, Sept. 1864 (Ber, L). Sachsen: aus einem Teiche in Bernbruch bei Lausigk, *P. Richter*, Juli 1864 (Rabenh. Alg. 1791, as *Coelosphaerium Kuetzingianum*, FM); Mannsfeld, *M. Marsson*, Juli 1896 (N); Leipzig, Lindenau, *Marsson*, Sept. 1897 (N); Teich in Collau am Mulde, *Marsson*, Sept. 1897 (N); in Gohlis bei Leipzig, *Richter*, Sept. 1878 (N), *Auerswald*, Sept. 1852 (Ber); Leipzig, *Richter* (FM); in lacu salso Mansfeldensis prope Halam Borussiae (TYPE of *Polycystis scripta* Richt. in Hauck & Richt. Phyk. Univ. 92, Ber; Isotypes, L, Min); Brösen bei Grimma, *Richter*, Aug. 1894 (Hauck & Richt. Phyk. Univ. 748a, L, Min, N); in einem Teiche bei Anger, Leipzig, *Richter*, Aug. 1879 (L, Pa, T); auf Teichen, Moritzburg (L); auf einem Fischteiche, Ponikau, *Auerswald* (Ber, F, FM, N), Juli 1852 (Rabenh. Alg. 210, Ber, FM, L, Min, N, Ne); in einem Teiche, Leipzig, *Auerswald* (FM); Lipsiae, *Kunze* (TYPE of *Microcystis ichthyoblabe* Kütz., Ber; Isotypes, FM, N, Pa); in einem Graben am Grossen Garten in Dresden, *C. Schiller*, Juli 1888 (Hauck & Richt. Phyk. Univ. 296b, L, Min); Schadebach bei Makranstadt (Leipzig), *H. Reichelt* (Hauck & Richt. Phyk. Univ. 297, L. Min). Thüringen: Georgenthal, in einem Teich am Bahnhof, *W. Migula*, Sept. 1928 (FM; Mig. Krypt. Germ. Austr. Helv. Exs. 242, T); Burgsee bei Salzungen, *A. Braun*, Sept. 1862 (TYPE of *Polycystis viridis* A. Br., Rabenh. Alg. 1415, FM, L, Min, N, Ne); Salzunger See, *A. Röse* (Rabenh. Alg. 453, as *Microhaloa firma*, F, FM, L, N, Ne); Salzsee bei Halle, *O. Kuntze* (N). Bayern: Nürnberg, *P. Reinsch* (Mi); in Wassertümpeln bei Erlangen, *Glück*, Sept. 1895 (L, U); Erlangen, *Reinsch* (N, U); Würmsee, *F. Brand*, Sept. 1897 (ISOTYPE of *Polycystis ochracea* Brand, Ber). Östermark: Vindobonae in piscinis hortorum publicorum, *K. Rechinger* (Krypt. Exs. Mus. Vindob. 2335, Ber, L, N); Vindobonae in piscinis horti Caesarei Schönbrunn, *C. de Keissler* (Krypt. Exs. Mus. Vindob. 1517, Ber, L, N, U). Schlesien: Galgenberge bei Strehlen, *Hilse* (Ber; Rabenh. Alg. 1522, Ber, FM, L, N, Ne), in Rohrteiche, *Hilse*, Juli 1859 (Rabenh. Alg. 1174, Ber, FM, Min, N, Ne), Strehlen, *Hilse* (Ber, L); bei Habendorf, *Hilse 8* (Ber); am Grossteiche von Habendorf bei Reichenbach, *Hilse*, Sept. 1862 (Ber); Rausern bei Breslau, *W. Migula*, Juli 1877 (Hauck & Richt. Phyk. Univ. 296a, L, Min), Mai 1887 (Mig. Krypt. Germ. Austr. Helv. Exs. 30, Mi, N, T); Breslau, *O. Kirchner*, 1874 (Rabenh. Alg. 2424, L, Min. N, Ne, T); im Teiche bei Schoffschütz in Oberschlesien, *A. Utgenannt & S. Schmula*, Sept. 1895 (Hauck & Richt. Phyk. Univ. 684 as *Polycystis elabens*, L, Min, N); grosser Teich in Buchwald bei Schmiedeberg,

G. Hieronymus, Sept. 1887 (Ber). Hamburg: an der Aussen-Alster, *P. Hennings*, Aug. 1886 (Ber). Baden: Schwetzingen, *Mettenius* (Ber). Württemberg: Stuttgart, bassins du Jardin Royal, *G. v. Martens* (L), in den Seen des Schlossgartens, *Martens* (Ber, L, N), *Hohenacker* (Ber); Stuttgart, *Martens* (TYPE of *Microcystis aeruginosa* Kütz., L; Isotype, Ber), Juni 1827, Aug. 1830, Aug. 1847 (Ber).

MORAVIA: près Eisgrub (L). HUNGARY: in excavationibus 'Lágymányosi holt Dunaág', Budapest, *F. Filarszky*, Mai 1911 (Fl. Hungar. Exs. 1 (Alg. 1): 21, FM, L, U); in lacu 'Városligeti tó', Budapest, *Filarszky* (Krypt. Exs. Mus. Vindob. 226, Ber, L, N). ITALY: Trieste, *F. Hauck* (D, F, N). NETHERLANDS: Haagsche Bosch, den Haag, *W. F. R. Suringar D18*, Mei 1857 (D, L); Witte Singel, Leiden, *J. T. Koster 233*, Aug. 1938 (L); in aq. dulc. stagn., Lugd.-Batav., *van den Bosch 376*, Aug. 1846 (L), idem, in stagnis pr. Leyden (Ber); Holland, *Weber van Bosse*, Oct. 1891 (L); forest, The Hague, *W. Trelease*, June 1884 (Mo). FRANCE: Falaise, Calvados, *A. de Brébisson 594* (L), dans les cavites des rochers, *Brébisson 528* (L), flottant sur les eaux, *Brébisson* (Ber); Carentan, Manche (Ber); Angers, Maine-et-Loire, *F. Hy* (Ber).

PORTUGUESE EAST AFRICA: Maloti Lake near Masiyeni, S. Chopiland, *E. L. Stephens 38*, June 1928 (D, N). SOUTH AFRICA: Rietkuil, Bethal Dist., East Transvaal, *M. E. Blenkiron & D. Weintroub 24*, Feb. 1928 (D).

MASSACHUSETTS: Arlington, *E. Dewart* (N); Horn Pond, Woburn, *W. G. Farlow*, Aug. 1879 (D, F); Fresh Pond, Cambridge, *H. H. Bartlett 1179*, Oct. 1907 (Mi), *Farlow*, Oct. 1882 (F, Mo), *G. T. Moore*, Oct. 1893 (B); Hammond Pond, Newton, *H. M. Richards*, Oct. 1889 (N), *W. A. Setchell* (F); Basin No. 3, Framingham, *Farlow*, Nov. 1881 (F); Brockton Water Works, *Supt.*, July 1887 (G); Oyster Pond, Falmouth, *A. W. Evans*, July 1896 (G); *Wm. R. Taylor*, Aug. 1922 (FM, Mi), *J. Bader*, July 1938 (D), *Drouet 2118*, July 1937 (D, F, N, S); 'Episcopal Ocean', Falmouth, *E. T. Rose & Drouet 1867*, July 1936 (D, N, S), *R. N. Webster*, June 1938 (D, F, N), *J. Bader*, July 1938 (D), *C. M. Palmer*, Sept. 1937 (Da, FM); Fresh Pond, Falmouth, *Wm. R. Taylor*, July 1921 (T); Long Pond, Nantucket, *Taylor & B. F. D. Runk*, July 1938 (D); north head of Hummock Pond, Nantucket, *Taylor* (D), 1920 (T); pond 1 mile south of Nonquitt, Dartmouth, *Rose & Drouet*, July 1936 (D); pond, Cuttyhunk Island, *F. S. Collins 5723*, Aug. 1907 (N); Ludlow Reservoir, Springfield, *Farlow*, Aug. 1876 (F). RHODE ISLAND: Mashapaug Pond, Providence, *W. J. V. Osterhout*, Oct. 1892 (Phyc. Bor.-Amer. 51, FM, L, Mi, Min, N, Ne); Providence, *Nichols*, June 1877 (D, F); Haley's Pond, Cranston, *Collins 6444*, Sept. 1911 (N). NEW YORK: Central Park, New York, July 1865 (Ber). PENNSYLVANIA: pond north of Kennett Square, *F. W. Pennell & W. S. May*, Oct. 1921 (T).

OHIO: Lake Erie, *L. H. Tiffany*, Aug. 1936 (FM), 1929 (FM), Put-in-Bay, *C. E. Taft*, Aug. 1938 (Da, FM, Taft); Goodale Park, Columbus, *E. H. Ahlstrom*, Oct. 1933 (Da, FM). KENTUCKY: pond near Walton, Boone County, *B. B. McInteer 13*, Aug. 1929 (Da, FM); sandpit, Greenwood Road near Louisville, *H. Bishop*, Oct. 1931 (Da, FM). TENNESSEE: Percy Warner Lake, Nashville, *H. C. Bold 13*, 1933 (FM); Radnor Lake, *Bold*, Oct. 1936 (FM). MICHIGAN: Pasinski Pond, Genoa Township, Livingston County, *W. F. Carbine*, 1938 (FM, T); Lake George, Oakland County, *C. E. Taft 155*, Aug. 1936 (Da, FM, Taft); with *Phormidium mucicola*, McDonald Lake, Yankee Springs, Hastings, *G. T. Velasquez*, Aug. 1936 (D, T); Three Lakes, Ann Arbor, *L. N. Johnson*, Sept. 1892 (F, N, Ne). INDIANA: Winona Lake, *C. M. Palmer 162, B436*, Aug. 1935 (D, Da, FM); Crooked

Lake, Steuben County, *Palmer B50*, Sept. 1933 (Da, FM); Lake Freeman, Carroll County, *Daily*, July 1938 (Da, FM); Beaver Dam Lake, 4 miles north of Silver Lake, Kosciusko County, *Daily 82*, June 1939; Calumet River north of Miller Station, Lake County, *P. D. Voth & Drouet 2367*, Sept. 1938 (FM, N). WISCONSIN: Madison, Fourth Lake, *Wm. Trelease*, 1882 (Mo), Spooner Lake, *Trelease* (Mo), Lake Mendota, *Trelease*, 1882 (D, F, Mo); Pleasant Lake, near Lauderdale Lakes, *G. W. Prescott 3W28*, Aug. 1938 (FM, Pr); High Lake, Vilas County, *Prescott 2W59*, June 1937 (FM, Pr); North Twin Lake, Polk County, *G. M. Smith*, Aug. 1917 (FM, Pr); Fish Lake, Burnett County, *Smith* (FM, Pr); pond east of Wild Rose near Silver Lake, *Prescott 2W330*, July 1937 (FM, Pr); Alequash Lake, *Prescott W155*, Aug. 1936 (FM, Pr), *2W268*, July 1937 (FM, Pr); Silver Lake, in Silver Lake, *E. H. Ahlstrom*, June 1932 (Da, FM). ILLINOIS: Lake County, Petit Lake near Antioch, Fox Lake, Lake Zurich, Slocum Lake 2 miles west of Wauconda, Pishtaka (or Pistakee?) Lake, Diamond Lake, Lake Marie near Antioch, *E. H. Ahlstrom*, June 1932 (Da, FM).

MINNESOTA: Lake of the Isles, Minneapolis, *K. Damann*, Aug. 1936 (Da, FM); Como Park, St. Paul, *J. E. Tilden*, Aug. 1895 (Tild. Amer. Alg. 194B, Ber, FM, Min, N, Ne, U); Long Lake, Hennepin County, *B. T. Shaver & Tilden*, Sept. 1895 (Tild. Amer. Alg. 194A, Ber, FM, Min, N, Ne, U); Lake at Waterville, *J. C. Arthur*, July 1882 (F); Fountain Lake, June 1936, Bowstring Lake, Chippewa National Forest, July 1936, Round Lake, July 1938, McCarron's Pond, Aug. 1931, Cross Lake just north of Minneapolis, Sept. 1936, Kandiyohi Lake, Sept. 1938, Iowa Lake, Aug. 1938, Ottertail Lake, Sept. 1938, Heron Lake, Jackson County, July 1938, *C. B. Reif comm. ex Coll. Bur. Fish.* (Da, FM). IOWA: Center Lake, *Prescott 317*, July 1925 (D, N); Miller's Bay, Lake Okoboji, *Prescott 316*, June 1925 (D, N); Lake East Okoboji, *Prescott 338*, June 1926 (D) MISSOURI: St. Louis, *G. T. Moore*, Aug. 1913 (D); plankton of lake, Pertle Springs, Warrensburg, *Drouet 778*, Oct. 1930 (D); Agriculture Pond, Columbia, *Drouet 990*, July 1932 (D). LOUISIANA: pond in pasture 1 mile northwest of Baton Rouge, *Prescott La17*, June 1938 (D). NEBRASKA: Cherry County, Hackberry, Dewey, and Watts Lakes, *E. R. Walker & E. N. Andersen*, July 1912 (Ne), Hackberry Lake, *E. Palmatier*, July 1936 (Ne). KANSAS: stagnant pond, Pittsburg, *R. Patrick*, Sept. 1938 (FM). COLORADO: Barr Lake, Adams County, *R. Prettyman*, July 1939 (FM). UTAH: *M. E. Jones*, 1895 (F); Strawberry Reservoir, Wasatch County, *Utah Party, U. S. Bur. Fish. comm. S. Wright*, Mar. 1933 (FM), *A. S. Hazzard F16*, Aug. 1933 (FM). ARIZONA: Station 13, Mary's Lake, Flagstaff, *H. S. Colton*, 28 Aug. 1923 (TYPE of *Microcystis aeruginosa* f. *occidentalis* Wm. R. Taylor, T). WASHINGTON: Green Lake, Seattle, *N. L. Gardner*, Dec. 1903 (Phyc. Bor.-Amer. 1153, FM, L, Mi, Min, N, Ne, T, U); Fidalgo Island, *L. E. Griffin*, Summer 1938 (FM).

GUATEMALA: Lake Amatitlan, *S. E. Meek 1* (TYPE of *Clathrocystis robusta* Clark, FM), *9, 11, 16, 21, 25*, Feb. 1906 (FM). PANAMA CANAL ZONE: Barro Colorado Island, *A. M. Chickering*, Aug. 1936 (D, F, L, N, Pr, S).

BRAZIL: Parahyba: lake near Campina Grande, *S. Wright 2017*, July 1934 (D), *1573*, Nov. 1934 (D), Açude Puxinaná, *1565, 1568, 1574, 1592, 1985, 1998, 2000, 2019*, Mar. 1934—Jan. 1935 (D), Açude Simão, *1572, 1608, 1967, 1999*, Feb. 1934—Mar. 1935 (D), Açude Lapa, *1559*, Jan. 1935 (D), Açude Baixo de Pão, *2041*, Dec. 1933 (D), Açude Velho, *1558, 1561, 1567, 1570, 1578, 1587, 1589, 1606, 1992, 2004*, May 1934—Mar. 1935 (D, F, L, N, S); Açude Linda Flôr near Mojeiro de Baixo, *Wright 1562*, Nov. 1934 (D, Mi, N); Açude Esperança near Esperanca.

Wright 1974, 2043, Dec. 1933 (D, S); açude near Serra Branca, *Wright 1995*, Apr. 1934 (D). Ceará: Lagôa Porangabuçú, Fortaleza, *Drouet 1504*, Dec. 1935 (D, N); Açude Cedro, Quixadá, *Wright & P. Azevedo 1539*, Aug. 1935 (D, F, Mi, N); Açude São Francisco near São Francisco, *Wright*, Nov. 1937 (D, F, N). Pará: in small bays, Rio Tapajóz, *J. W. H. Trail 165* (TYPE of *Microcystis caerulea* Dickie, BM). ARGENTINA: Buenos Aires: Laguna Los Chilenos near Dufaur, *Wright 2113*, Jan. 1937 (D); Laguna Chascomus, *Wright 2101*, Nov. 1936 (D); Laguna Blanca Grande, *Wright 2098*, Jan. 1937 (D, F, L, N, S). San Luis: Laguna Tala, *Wright 2111*, Dec. 1936 (D); Laguna La China, *Wright 2112*, Dec. 1936 (D); Laguna Garcia, *Wright 2096*, Dec. 1936 (D).

PHILIPPINE ISLANDS: Pasig River, Manila, *W. R. Shaw 347*, Mar. 1909 (Ber, L, N, U), *E. Quisumbing 9*, 1929 (T). CAMBODIA: im Bien-ho [Toulé-Sap], *O. Kuntze*, 1875 (N). INDIA: Bombay, in einem Bassin der 'Victoria-Garden', *A. Hansgirg*, Nov. 1895 (Hauck & Richt. Phyk. Univ. 748B, L, Min, N), Sept. (ISOTYPE of *Polycystis insignis* Beck, Krypt. Exs. Mus. Vindob. 227, N); Teichen bei Calcutta, *S. Kurz 1756*, Mai 1867 (Ber). CEYLON: *W. Ferguson 276, 295* (L).

This is the common species of Microcystis which develops as copious water-blooms in lakes, ponds, and streams. Where sparsely represented in the plankton, there is often seen a predominance of spherical plants; to this form the name *M. flos-aquae* has been chronically misapplied in recent years. Wittrock's original description and type collection of *Polycystis flos-aquae* refer unmistakably to material of a heavy water-bloom in which the individual plants are agglutinated and almost or entirely confluent with each other.[1] The original specimens of *P. prasina* are similar to those of *P. flos-aquae* except in color of the masses. The type collection of *P. scripta* contains predominantly elongated and branched plants. The original collections of *Microcystis ichthyoblabe* Kütz. and *Polycystis viridis* A. Br. consist principally of plants with conspicuously delimited gelatin; in the latter, the plants are small and few-celled. Plants which are clathrate or which have depressions in their surfaces have in general been referred in the past to *Microcystis aeruginosa* (or *Clathrocystis aeruginosa*) as described by Henfrey. Original specimens of *M. aeruginosa* f. *occidentalis* Wm. R. Tayl., *M. caerulea* Dickie, *Polycystis insignis* Beck, *P. ochracea* Brand, and *Clathrocystis robusta* Clark have no distinctive features by which we can separate them from *Microcystis aeruginosa* Kütz. as treated here.

[1] Wittrock's original description (Wittr. & Nordst., Alg. exs. 298) reads: "P[olycystis]. thallo mucoso difformi, sublutescente-aeruginoso (colore thalli siccati vix mutato); familiis confertis, vix distinctis; cellulis globosis, corpore phycochromaceo structura verosimiliter eadem ac in *P. prasina;* diametro cellularum 4½–6½ μ." The forms indicated under the name *Microcystis flos-aquae* by Kirchner in Engler & Prantl, Naturl. Pflanzenfam. 1(1): 56 (1900), Forti in Sylloge Myxophyc. 86 (1907), and Geitler in Rabenh. Kryptogamen-Fl. 14: 138 (1930) differ considerably among themselves and each from that indicated by Wittrock.

Nomina Excludenda

The following names are to be excluded from the group. Type and otherwise authenticated specimens are here referred to other genera of plants and animals.

Anacystis amplivesiculata Gardn., Mem. New York Bot. Gard. 7: 22 (1927)=GLOEOCAPSA SP.

A. anomala Gardn., ibid. 7: 26 (1927)=GLOEOCAPSA SP.

A. compacta Gardn., ibid. 7: 20 (1927)=GLOEOCAPSA SP.

A. consociata Gardn., ibid. 7: 25 (1927)=GLOEOCAPSA SP.

A. cylindrica Gardn., ibid. 7: 19 (1927)=GLOEOTHECE SP.

A. distans Gardn., ibid. 7: 21 (1927)=GLOEOCAPSA SP.

A. elabens Setch. & Gardn., Univ. Calif. Publ. Bot. 6: 455 (1918)=APHANOTHECE ELABENS Drouet & Daily.[1]

A. gigas Gardn., Mem. New York Bot. Gard. 7: 15 (1927)=GLOEOCAPSA GIGAS West & West f.

A. gloeocapsoides Gardn., ibid. 7: 22 (1927)=GLOEOCAPSA SP.

A. irregularis Gardn., ibid. 7: 24 (1927)=GLOEOCAPSA SP.

A. magnifica Gardn., ibid. 7: 21 (1927)=GLOEOCAPSA GIGAS West & West f.

A. marginata Menegh., Consp. Fl. Eugan. 6 (1837)=APHANOTHECE SP.

A. microsphaeria Gardn., ibid. 7: 22 (1927)=GLOEOCAPSA SP.

A. minutissima Gardn., ibid. 7: 25 (1927)=GLOEOCAPSA SP.

A. nidulans Gardn., ibid. 7: 23 (1927)=GLOEOCAPSA SP.

A. nigropurpurea Gardn., ibid. 7: 18 (1927)=GLOEOCAPSA SP.

A. nigroviolacea Gardn., ibid. 7: 19 (1927)=GLOEOCAPSA SP.

[1] APHANOTHECE **elabens** (Bréb.), **comb. nov.** *Microhaloa elabens* Bréb. in Menegh. Monogr. Nostoch. Ital., 104 (1842). *Polycystis elabens* Kütz., Tab. Phyc. 1: 7 (1846). *Microcystis elabens* Kütz., ibid. 1: 6 (1846). *Anacystis elabens* Setch. & Gardn., Univ. Calif. Publ. Bot. 6: 455 (1918).—This species (if we can judge by labels and contents of Brébisson's collections) inhabits brackish waters of low salinity. The plants are small and somewhat reminiscent of species of Microcystis in the treatment above; however, the protoplasts are elongate as in other species of Aphanothece. The only adequate illustration which we have discovered is that in Desmazières, *Plantes Cryptogamiques de France*, No. 1952. *A. elabens* has been reported frequently under its various synonyms; most of the specimens thus labeled from Europe and America are to be interpreted as of species of Aphanocapsa, Chlorogloea, Entophysalis, and Gloeocapsa, and as *Microcystis aeruginosa* of this paper. Specimens of *Aphanothece elabens* seen: FRANCE: Falaise, Calvadoz, *Brébisson* (TYPE: L; isotype, Ber), *Lenormand* (Ber); in stagnis et turfosis circa Falaise, *Brébisson* (Rabenh. Alg. 2178, Ber, L, N, Ne); dans les flaques des tourbières d'un petit marais des environs de Falaise, *Brébisson* (Desmaz. Pl. Crypt. France 1952, N); Etang d'Aix près Marseille, *herb. Bornet* (F).

Anacystis paludosa Rabenh., Fl. Eur. Algar. 2: 52 (1865)=OPHRIDIUM SP.

A. parasitica Kütz., Tab. Phyc. 1: 7 (1846)=APHANOCAPSA SP.

A. pulchra Gardn., ibid. 7: 23 (1927)=GLOEOCAPSA SP.

A. radiata Gardn., ibid. 7: 26 (1927)=GLOEOCAPSA SP.

A. radiata var. *major* Gardn., loc. cit. (1927)=GLOEOTHECE SP.

A. Reinboldii Richt. in Hauck & Richt., Phyk. Univ. 9: 447 (1891)=APHANOCAPSA SP.

A. Willei Gardn., ibid. 7: 24 (1927)=GLOEOCAPSA SP.

Microcystis austriaca Kütz., Tab. Phyc. 1: 7 (1846)=EUGLENA SP.

M. Donnellii Wolle, Bull. Torr. Bot. Club 6: 282 (1879)=ciliate protozoa.

M. elabens Kütz., ibid. 1: 6 (1846)=APHANOTHECE ELABENS Drouet & Daily (see footnote 2 of this paper).

M. firma Schmidle, Engl. Bot. Jahrb. 32: 57 (1902)=Flagellata.

M. ichthyoblabe var. *violacea* Forti, Syll. Myxophyc. 89 (1907)=Nostocaceae (specimina manca)?

M. littoralis Forti, Syll. Myxophyc. 89 (1907)=APHANOTHECE SP.

M. lobata Dickie, Journ. Linn. Soc. Bot. 18: 128 (1880)=ANABAENA CIRCINALIS Born. & Flah.

M. marginata Kütz., Tab. Phyc. 1: 6 (1846)=APHANOTHECE SP.

M. minor Kütz., Tab. Phyc. 1: 11 (1846)=Flagellata.

M. Noltii Kütz., Linnaea 8: 342 (1833)=EUGLENA SP.

M. olivacea Kütz., Phyc. Gener. 170 (1843)=EUGLENA SP.

M. paludosa Forti, Syll. Myxophyc. 92 (1907)=OPHRIDIUM SP.

M. parasitica Kütz., Phyc. Gener. 170 (1843)=APHANOTHECE or CHLOROGLOEA SP.

M. Paroliniana Menegh., Monogr. Nostoch. Ital. 78 (1842)=GLOEOCYSTIS PAROLINIANA Rabenh.

M. Reinboldii Forti, ibid. 91 (1907)=APHANOCAPSA SP.

M. rupestris Kütz., Linnaea 8: 374 (1833)=GLOEOTHECE SP.

M. umbrina Kütz., ibid. 373 (1833)=Fungi.

Clathrocystis roseo-persicina Cohn, Beitr. Biol. Pflanzen 1: 157 (1875)=LAMPROCYSTIS ROSEO-PERSICINA Schroet.

Microhaloa elabens Bréb. in Menegh., Monogr. Nostoch. Ital. 104 (1842)=APHANOTHECE ELABENS Drouet & Daily (see footnote 2 of this paper).

Microcystis firma Kütz., Tab. Phyc. 1: 6 (1846)=Flagellata and APHANOCAPSA SP.

M. pallida Kütz., ibid. 1: 6 (1846)=Flagellata.

M. rupestris Kütz., Phyc. Gener. 169 (1843)=GLOEOTHECE SP.

Polycystis elabens Kütz., Tab. Phyc. 1: 7 (1845)=APHANOTHECE ELABENS Drouet & Daily (see footnote 2 of this paper).

P. firma Rabenh., Fl. Eur. Algar. 2: 53 (1865)=Flagellata and APHANOCAPSA SP.

P. ichthyoblabe b. *purpurascens* A. Br. in Rabenh., Krypt.-Fl. Sachsens 74 (1863)=Bacteria?

P. littoralis Hansg. in Foslie, Mar. Alg. Norway 169 (1890)=APHANOTHECE SP.

P. marginata Richt., Hedwigia 1885: 20 (1885)=APHANOTHECE SP.

P. Packardii Farl., Amer. Nat. 13: 703 (1879)=APHANOTHECE PACKARDII Setch.

P. pallida Farl., Mar. Alg. New Engl. 28 (1881)=Flagellata.

P. violacea Itzigs., Rabenh. Alg. Sachs. 31–32: 306 (1853)=Nostocaceae (specimina manca)?

Nomina Inquirenda

The following names, for which no original material has been seen during this study, appear to be referable (according to descriptions and figures) to other groups of organisms than Microcystis.

Anacystis brunnea Wolle, Fresh-w. Alg. U. S., 329 (1887); *A. Grevillei* Kütz., Sp. Algar. 200 (1849).

Clathrocystis elongata Forti, Syll. Myxophyc. 96: (1907); *C. reticulata* Lemm., Bot. Centralbl. 76: 153 (1898).

Microcystis angulosa Kütz., Linnaea 8: 374 (1833); *M. atra* Kütz., ibid. 375 (1833); *M. atrovirens* Kütz., ibid. 374 (1833); *M. densa* G. S. West, Journ. of Bot. 47: 244 (1909); *M. deusta* Menegh., Monogr. Nostoch. Ital. 81 (1842); *M. fuscolutea* Forti, ibid. 92 (1907); *M. Grevillei* Kütz., ibid. 372 (1833); *M. mellea* Menegh., ibid. 83 (1842); *M. merismopedioides* Fritsch, Journ. Linn. Soc. Bot. 40: 333 (1912); *M. piscinalis* Forti, ibid. 90 (1907); *M. protogenita* Rabenh., Fl. Eur. Algar. 2: 31 (1865); *M. punctiformis* Kirchn., Alg. Schles. 256 (1878); *M. rosea* Kütz., ibid. 373 (1833); *M. sanguinea* Kütz., ibid. 372 (1833); *M. violacea* Kütz., ibid. 373 (1833).

Microhaloa aurantiaca Kütz., Phyc. Gener. 145 (1843); *M. botryoides* Kütz., ibid. 169 (1843); *M. iodes* Itzigs. in Rabenh., Fl.

Eur. Algar. 2: 53 (1865); *M. Pini-turionum* Bias., Di Alc. Algh. Microsc. 47; *M. protogenita* Bias., loc. cit.; *M. rosea* Kütz., Linnaea 8: 371 (1833).

Polycystis fuscolutea Hansg., Prodr. Algenfl. Böhmen 2: 145 (1892); *P. piscinalis* Brügg., Bündn. Alg. 249; *P. reticulata* Lemm., Bot. Centralbl. 76: 153 (1898).

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